UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

DISTRICT C

FINAL REPORT OF NONFATAL COAL-MINE BUMP ACCIDENT

MINE NO. 10
WISCONSIN STEEL COAL MINES
INTERNATIONAL HARVESTER COMPANY
BENHAM, HARLAN COUNTY, KENTUCKY

August 19, 1967

by

J. L. Gilley
Mining Health and Safety Engineer

Originating Office, Bureau of Mines
Norton, Virginia 24273
J. S. Malesky, District Manager
Health and Safety District C

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INTRODUCTION

This report is based on an investigation made in accordance with provisions of the Federal Coal Mine Safety Act (66 Stat. 692; 30 U.S.C. Secs. 451-483) as amended.

A coal outburst, or bump, that caused minor injuries to 4 employees occurred at 1:30 a.m. Saturday, August 19, 1967 in the 2 left butt section off 5 left entries off north main entries in Mine No. 10, Wisconsin Steel Coal Mines, International Harvester Company. Three other employees, including the foreman employed on the section, were not injured; and they assisted with the rescue of and administered first-aid to the injured persons who subsequently were taken to the hospital at Benham, Kentucky for examination and treatment. Steve Scott, roof bolter, age 50 with 22 years mining experience received contusions, back of both legs, and lacerations to the base of the skull; John Rogers, continuous mining machine operator, age 37 with 19 years mining experience, received abrasions of the right side of the neck; James M. Marlow, roof bolter (helper), age 44 with 21 years mining experience, received minor injuries; Walter Rogers, continuous mining machine operator (helper), age 35 with 15 years mining experience, received minor injuries. Steve Scott and John Rogers lost 30 and 9 days work respectively, but James M. Marlow and Walter Rogers did not lose any work time.

A company official notified the Norton Office of the Bureau of Mines about the occurrence on Monday, August 21, 1967. An investigation was started the following day and was completed on August 24, 1967.

Information for this report was procured from examinations of the section involved, which, with the exception of the removal of the equipment, remained undisturbed, and from statements of eyewitnesses

and mine officials. Accessible mined areas of the section involved and the mine maps, including those of the superjacent coalbeds; and logs of 3 boreholes nearest the scene of the outburst were examined. The areas, in the "B", "C", and "D" coalbeds situated directly over the scene of the outburst in the "A" coalbed, were not accessible for examination.

GENERAL INFORMATION

Mine No. 10 at Benham, Harlan County, Kentucky, was opened in 1964, and is served by the Louisville and Nashville Railway. The mine is operated in the high-volatile bituminous Harlan coalbed (locally designated as the "A" coalbed and is designated as such in this report) through several drifts and a rock slope. The coalbed thickness in the area involved is 77 inches, but decreases to 60 inches in other portions of the mine. The coal, possessing distinct face and butt cleavage planes, is characteristically black and shiny, and is comparatively hard. In the area involved, the upper half of the coalbed contains 3 comparatively hard intercalations of shale that range from 2 to 8 inches in thickness. The characteristic hardness of the coal in combination with the layers or "bands" of hard shale causes the coal pillars to shatter and break somewhat readily under stress or blow. These factors indicate that the larger coal pillars are capable of developing considerable latent energy, and therefore, are prone to coal bursts, especially if they are located in zones of multiple abutment loading within the same coalbed and/or from contiguous coalbeds where the natural conditions are favorable for bumps.

Employment at the completion of the last Federal inspection of Mine No. 10 on July 6, 1967, totaled 190 men, 40 of whom worked on the surface and 150 underground on a double-shift basis, 5 days a week, and produced a daily average of 5,100 tons of coal. The coal is loaded with conventional loading machines and two Lee-Norse continuous mining machines, types CM 34 and CM 38 D1. Coal is transported from the working faces to discharge terminals by shuttle cars and thence to the surface by a conveyor belt system.

The mine is developed by a multiple-entry system and final mining follows a room-and-pillar method of development; however, complete extraction of the coal pillars is not practiced.

Main entry development consists of 5 entries on 70-foot centers and the face-entry and the butt-entry development consists of groups of 3 and 5 entries on 75-foot centers. Entry widths ranged from 16 to 18 feet with crosscuts at 70-foot intervals. Distance between the butt, or room, entries varies from 250 to 450 feet. Rooms are projected on 60-foot centers, 18-20 feet in width, and 230 to 250 feet in length with crosscuts at 60- to 75-foot intervals.

Final mining of coal pillars is by a "honey-comb", or partial extraction, system in which a "split", or pocket, 20 - 24 feet in width is mined through the pillar midway between the crosscuts of the rooms and entries, thus leaving "wings" or pillar stumps, approximately 10- by 40-feet in dimensions.

Mine No. 10 is located near the center of the Cumberland Gap coalfield, which occupies a northeasterly - trending synclinal basin nearly 90 miles long and 15 to 20 miles wide, that is bounded by Pine Mountain Ridge on the northwest, and the Cumberland Mountain Ridge on the southeast. The irregular crests of the Black Mountain within the property have elevations in excess of 3,800 feet; the maximum depth of cover encountered on the property is approximately 2,000 feet. The depth of cover over the 2 left butt, 5 left face entry (scene of bump) ranges from 1,500 to 1,600 feet.

Localized dispositional changes occur in the immediate roof overlying the "A", or Harlan, coalbed in many areas of the mine; however, in the 2 left butt and the 3 left butt section off 5 left entries, the immediate roof is predominately dark gray shales with varying degrees of hardness and thickness, according to the logs of 3 boreholes nearest the bump area. Figure 4 of this report contains the logs of 2 of the 3 boreholes within 2,000 feet of the scene of the outburst. The main roof formation, over the "A" coalbed, consists of interbedded sandstones, sandy shales, and fine-grained shales with two to three beds of "wild" coal.

The immediate and main roof overlying the "B" or Marker coalbed is comprised of dark gray shale, 16 to 22 feet thick.

The immediate roof overlying the "C" or Kellioke coalbed, consists of 3 to 10 feet of gray shale overlain by a stratum of sandstone 50 to 60 feet thick.

The immediate roof overlying the "D" coalbed varies from sandstone to shales overlain by several strata of sandstone that range from a few feet to more than 90 feet in thickness.

The immediate floor underlying the 4 coalbeds on this property consists of shales that range from 2 to 12 feet in thickness. This shale floor under 3 of the coalbeds is underlain by sandstone ranging from 50 to 75 feet in thickness. The floor under the "A" coalbed is soft shale that "flows" or heaves radily under pressure. Floor heaving usually occurred to some extent within a few hours following development of the entries and rooms in the 2 and 3 left butts area.

Roof bolts, 3/4-inch in diameter, 48-72 inches in length, installed on 4-foot centers in accordance with plans approved by a Bureau of Mines roof-control representative, were used in the 2 left butt section. Posts were used to supplement the roof bolts along the belt line and

at doubtful roof areas in the entries and rooms. Posts were used at the entrances to the pillar splits and as temporary roof support during the various mining operations.

Coal outbursts of consequence had not occurred previously in the "A" coalbed; however, bursts of varying intensity have occurred in the "B", "C", and "D" coalbeds in which mining was discontinued in 1964, 1948, and 1965, respectively. Reportedly, selective extraction of barrier pillars is to start within the near future in the "C" coalbed.

Members of the committee participating one or more days in the investigation of August 22-24, 1967, were:

Company Officials

C. H. Irwin	General Superintendent
Earl Lewis	Mine Superintendent
R. P. Hightower	Chief Engineer
Norman Yarborough	Supervisor of Raw Materials (Steel Division)
Raymond Williams	Mining Engineer
Charles Bundy	Assistant General Mine Foreman
James Jaco	Face Foreman

Progressive Mine Workers of America

John Rogers	Continuous Miner Operator
Walter Rogers	Continuous Miner (Helper)
Hobart Golden	Mechanic

Kentucky Department of Mines and Minerals

Carl Smithers	Inspector-in-Charge

United States Bureau of Mines

J. L. Gilley	Mining Health and Safety Engineer
Jack E. Tisdale	Technical Assistant

DESCRIPTION OF OCCURRENCE

Mining operations had been interrupted because of sporadic equipment failures and other conditions with a decrease in production during the operating shifts on August 18. Because of the delays and consequent decrease in coal production, the operating officials decided to continue production of coal for a period of 4 hours following the end of the 3:15 - 11:45 p.m. evening shift (August 18) with a make-

up crew. It consisted of John Rogers, continuous miner operator, Walter Rogers, miner-operator (helper), Steve Scott, roof-bolter, and James Jaco, face foreman, all members of the evening shift crew and James Marlow, roof-bolter, Joe Casolari, mechanic and shuttle-car operator, and Hobart Golden, mechanic, from the 12:01 - 8:00 a.m. utility shift. After assignments to the men by Jaco, the face foreman, normal coal production operations started (near midnight) in the 2 left butt section.

From Figure 2, it will be noted that rooms, including Nos. 12, 13, and 14, were projected on 60-foot centers, 16 to 18 feet in width in the 2 left butt room panel barrier. Development of these 3 rooms was started on the evening shift of August 18, after completion of No. 15 room. The faces of Nos. 13 and 14 rooms were advanced about 34 feet, respectively, and No. 12 room face about 16 feet.

On the shift during which the outburst occurred, normal mining operations had started in the No. 12 room, and the roof-bolting crew, after procuring necessary supplies, started bolting the roof in No. 13 room. After about 16 linear feet of coal was mined in No. 12 room, the continuous miner was moved into No. 13 room where a normal cut of coal, 16 to 18 feet wide and 16 feet in length was mined. During mining of No. 13 room, the roof bolters installed roof bolts, according to plan, in No. 12 room. After completing the mining cycle in No. 13 room, the continuous miner was moved into No. 14 room and started mining coal at about 1 a.m. During the interim, the roof-bolting crew completed their assignment in No. 12 room, then moved the roof-bolting machine into No. 13 room and started installing bolts; thus, roof-bolting and mining operations were being done simultaneously in the face area of adjacent rooms.

Reportedly, mining conditions were normal in the Nos. 12 and 13 rooms; however, the miner operator and helper reported that the coal in the No. 14 room was relatively soft in comparison to the coal in the other rooms. The frequency and intensity of the thumping and bumping processes incidental to mining in the area during the mining cycles, reportedly were normal. However, the miner operator stated that after the face of No. 14 room had been advanced 10 to 12 feet the immediate roof began to spall near the face and there were indications of progressive fracturing. Mining at the face was stopped; the miner was moved 20 to 25 feet back from the face and the clean-up cycle (loading loose, fine coal from the floor) was started. At about 1:30 a.m. the miner operator, reportedly, positioned the miner on the right side of the place and proceeded to clean up loose coal toward the face. The continuous miner-operator (helper) was handling the miner cable as the machine advanced. When the continuous miner was within about 12 feet of the face, the outburst occurred. The roof-bolting crew in No. 13 room had installed two rows of bolts and was installing the second bolt in the third row at the time of occurrence.

Figures 1 and 2 indicate the mining system used, the extent of the development, final mining of pillars (partial extraction), the comparative dimensions of coal pillars, and the locations of men and equipment at the time of the outburst in the 2 left butt area affected by the bump. Correlation of the 2 left butt workings in the "A" coalbed with the relative projections of unmined pillars and mined-out areas in the superjacent "B" and "C" coalbeds is indicated in Figure 3.

The outburst was confined primarily to the Nos. 12, 13, and 14 rooms in 2 left butt; however, the resultant tremor caused coal to be shaken from the ribs of adjacent entry chain pillars and room pillar remnants (stumps) in close proximity to the epicenter of the occurrence. Coal was expelled violently from the left rib line against the miner in the No. 14 room and the room-face area was completely filled from the last row of roof bolts inby, a distance of approximately 12 feet. Reportedly, the miner was moved sidewise a short distance by the forces of the stress wave and the expelled coal. The miner operator was struck by particles of flying coal from the right rib of the place and Walter Rogers, the miner-operator's (helper), received bruises and a small laceration on the head. Coal was expelled from the left rib and face in the No. 13 room, but with considerably less force than in the No. 14 room. A portion of the coal expelled from the left rib of this place struck the roof bolting machine and severly bruised the legs of Scott, the roof-bolter, who was in the process of installing a roof bolt when the outburst occurred. Marlow, the roof bolter's helper, who was on the right side of the machine, was stunned momentarily, but otherwise was uninjured. Approximately 3 tons of coal was shaken from the ribs and face of the No. 12 room.

Roof material, other than small pieces of shale at a few places between roof bolts, was not dislodged in the active area; however, localized roof falls occurred in the mined-out No. 15 room inby and in an abandoned portion of the No. 1 entry of 2 left butt within a few hours following the outburst. Also, progressive heaving of the floor occurred in the 2 left butt entries and crosscut openings inby and for a short distance outby the No. 12 room after the burst. Several posts in the adjacent mined-out area were either bent or broken.

Dense clouds of dust were thrown into suspension, but reportedly, no methane was detected with a flame safety lamp in the area involved. The face foreman and a workmen, who were near the cutout switches cut off the power within a few seconds following the occurrence.

Recovery operations were conducted and first-aid rendered to the injured by the face foreman and the slightly injured workmen on the 2 left butt section and by other personnel who arrived on the section within a short time.

Mining in the 2 left butt section off 5 left entries at the time of the outburst consisted of developing rooms on 60-foot centers in a room panel barrier, 230 feet wide and 1,120 feet long, intervening between 2 left butt entries and the 3 left butt panel that had been completed on June 22, 1967. Following completion of the 3 left butt panel, development of the 2 left butt entries was started on June 26, 1967, and with the exception of the No. 3 entry, was completed on August 9, 1967, as indicated in Figure 2. From Figure 2, it will be noted that No. 18 room, projected in the inby portion of the 2 left butt panel, was not developed and that the face of the adjacent No. 17 room was advanced 70 feet then abandoned, reportedly, because of disturbances which affected the roof and floor. Rooms 15 and 16, reportedly, were developed without difficulty and the respective room pillars were mined by a "honey-comb", or partial extraction, system on August ~~17~~ 16 and ~~18~~ 17.

Weight was manifested in parts of the 2 left butt section, as indicated by sloughing of coal from the pillars, spalling and fracturing of the roof and heaving of the floor. From Figure 3, it will be noted that the Nos. 1 and 2 entries of 2 left butt terminated under a partially mined panel in the "B" coalbed and that the No. 3 entry of this group terminated directly under an undeveloped portion of the panel. Also, from Figure 3, it will be noted that the 2 left butt entry projections passed under areas in the "C" coalbed, that included first, a pillared area, then two protective coal barriers, each 230 feet thick, one on either side of a group of 3 entries, thence terminated under a pillared area.

The interval between the "A" and "B" coalbeds is about 160 feet; the interval between the "B" and "C" coalbeds is 16 to 40 feet and the interval between the "C" and "D" coalbeds is about 70 feet. The vertical distance between the "A" and "D" coalbeds ranges from 250 to 270 feet.

The "D" coalbed has been mined on part of the property by a partial extraction system; the workings at two locations terminated within 60 feet of being directly over the location of the outburst in the subjacent "A" coalbed. The cover over the "D" coalbed ranges up to 1,350 feet in thickness.

The four vertically adjacent coalbeds on the property were mined consecutively rather than by simultaneous multiple-seam mining, except that in a few instances, selected areas in 2 contiguous beds were mined simultaneously for short periods.

The "C" coalbed was the first to be mined and the pillars, except barrier pillar reserves, were extracted. Mining in the "B", "D", and "A" coalbeds followed consecutively, primarily, by a partial extraction

system; however, full mining of some pillars was done in each bed. Room center projections varied in the coalbeds in which partial mining plans were adopted; consequently, pillars of various dimensions exist in these beds.

CAUSE OF ACCIDENT

It is the opinion of the Bureau investigators that this coal outburst was an accumulative process from a combination of factors that ultimately caused an imposition of a shock load, upon the room panel barrier being mined, parts of which, undoubtedly were stressed prior to current mining.

From the foregoing description of the relationship of overburden, interval and nature of the strata, and the proximity of the three overlying coalbeds, the disturbance in the 2 left butt section (scene of accident) resulted primarily from weight transmission upon the coal being mined in the "A" or lower coalbed. The consequent distortion and concentration of stresses in the 2 left butt area are attributed to previous mining and to the mining systems used in the superjacent coalbeds overlain by a thick overburden. Other factors involved include: secondary development (mining) in a highly stressed portion of a pillar within compounded abutment zones and three rooms being driven abreast into a stressed pillar directly toward a mined-out area.

RECOMMENDATIONS

It is realized that the conditions which exist where multiple seam mining or consecutive mining of vertically adjacent coal beds within close proximity, such as the A, B, C, and D beds on this property, are so complex that the interaction of the various factors cannot be evaluated with precision; however, compliance with the following recommendations may minimize the coal outbursts at this mine in the future:

1. The plans for current and future mining should take into consideration the degree to which the effects of previous mining superjacent coalbeds will contribute to potential outbursts in the lower coalbed.

2. The mining plans should not incorporate areas in the A coalbed where, from past experience, a combination of factors indicate transmission of excessive weight from mining in the upper coalbeds overlain by a thick overburden.

3. Where there are disturbances in areas of the "A" coalbed and the natural conditions are conducive to outburst, rooms (such as the group involved) should not be driven abreast in highly stressed areas (abutment zones) of pillars toward the gob or mined-out areas. Staggering

the faces, at least one crosscut length, reduces the amount of exposure of workmen during the de-stressing processes that occur in the advancement of the faces.

4. The plans for partial extraction mining should be conducted as systematically as practicable to assure reasonable uniformity in the dimensions of unmined pillars to minimize irregular subsidence.

The following recommendation has no bearing on this outburst accident; however, it is believed its compliance will reduce outbursts under some conditions:

1. When mining in stressed areas with a continuous miner, the working face should be advanced as uniformly as practicable; mining of short-cuts ("runs") alternately across the face (loading of one shuttle car of coal) rather than mining two full sumps 16 to 18 feet in depth as formerly practiced, tends to reduce the pressure differential at the face, and thus minimize the frequency and severity of the thumping and bumping processes, factors that can initiate an outburst of consequence.

ACKNOWLEDGMENT

The cooperation of company officials, employees, members of union, and the representative of the Kentucky Department of Mines and Minerals during this investigation is gratefully acknowledged.

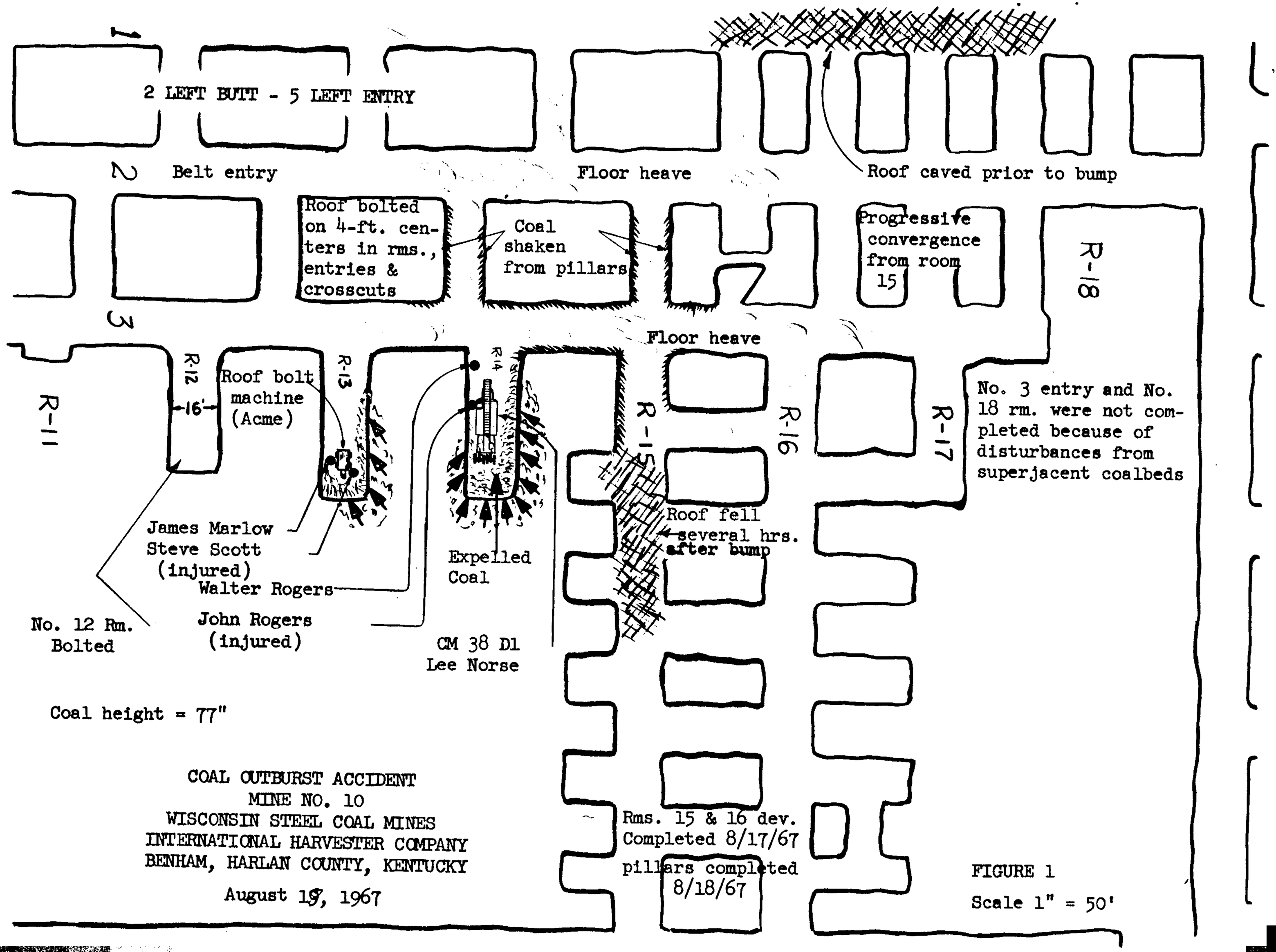
Respectfully submitted,

J. L. Gilley
Mining Health and Safety Engineer

Approved by:

/s/ J. S. Malesky

J. S. Malesky
District Manager



Coal height = 77"

COAL OUTBURST ACCIDENT
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FIGURE 1

Scale 1" = 50'

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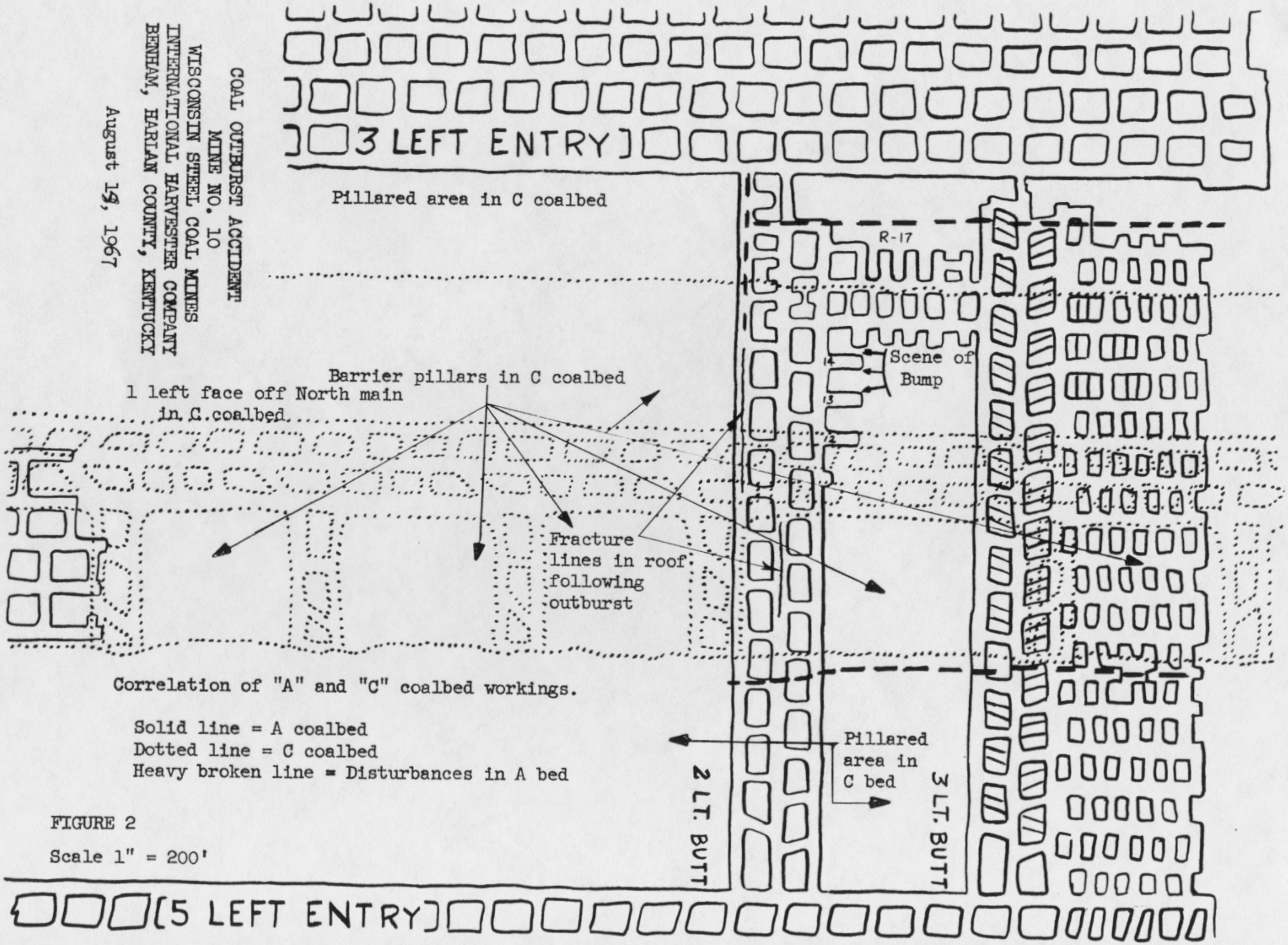


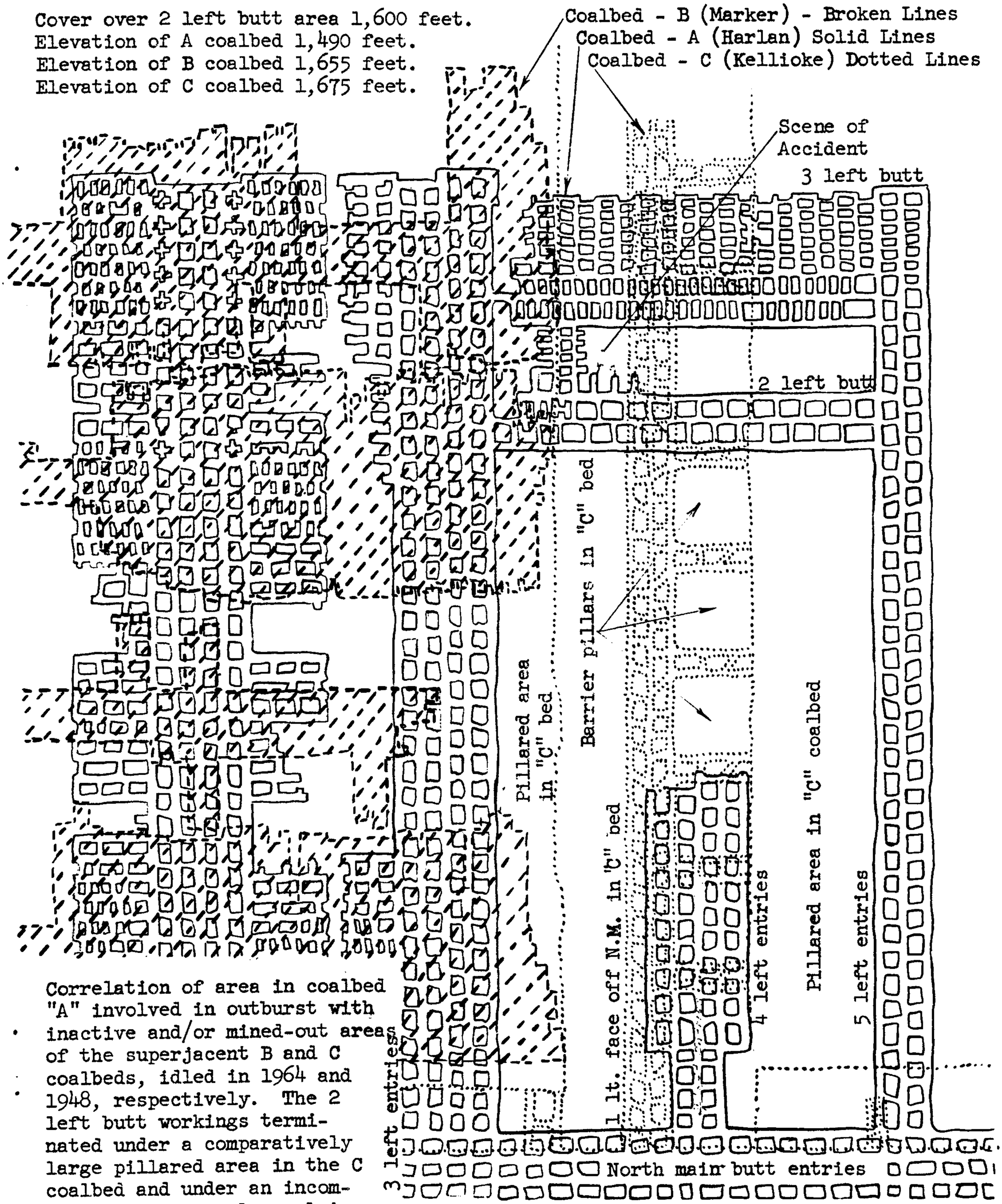
Correlation of "A" and "C" coalbed workings.

Solid line = A coalbed
Dotted line = C coalbed
Heavy broken line = Disturbances in A bed

FIGURE 2

Scale 1" = 200'

Cover over 2 left butt area 1,600 feet.
Elevation of A coalbed 1,490 feet.
Elevation of B coalbed 1,655 feet.
Elevation of C coalbed 1,675 feet.



Correlation of area in coalbed "A" involved in outburst with inactive and/or mined-out areas of the superjacent B and C coalbeds, idled in 1964 and 1948, respectively. The 2 left butt workings terminated under a comparatively large pillared area in the C coalbed and under an incompletely mined coal panel in the B coalbed.

FIGURE 3

Scale 1" = 400'

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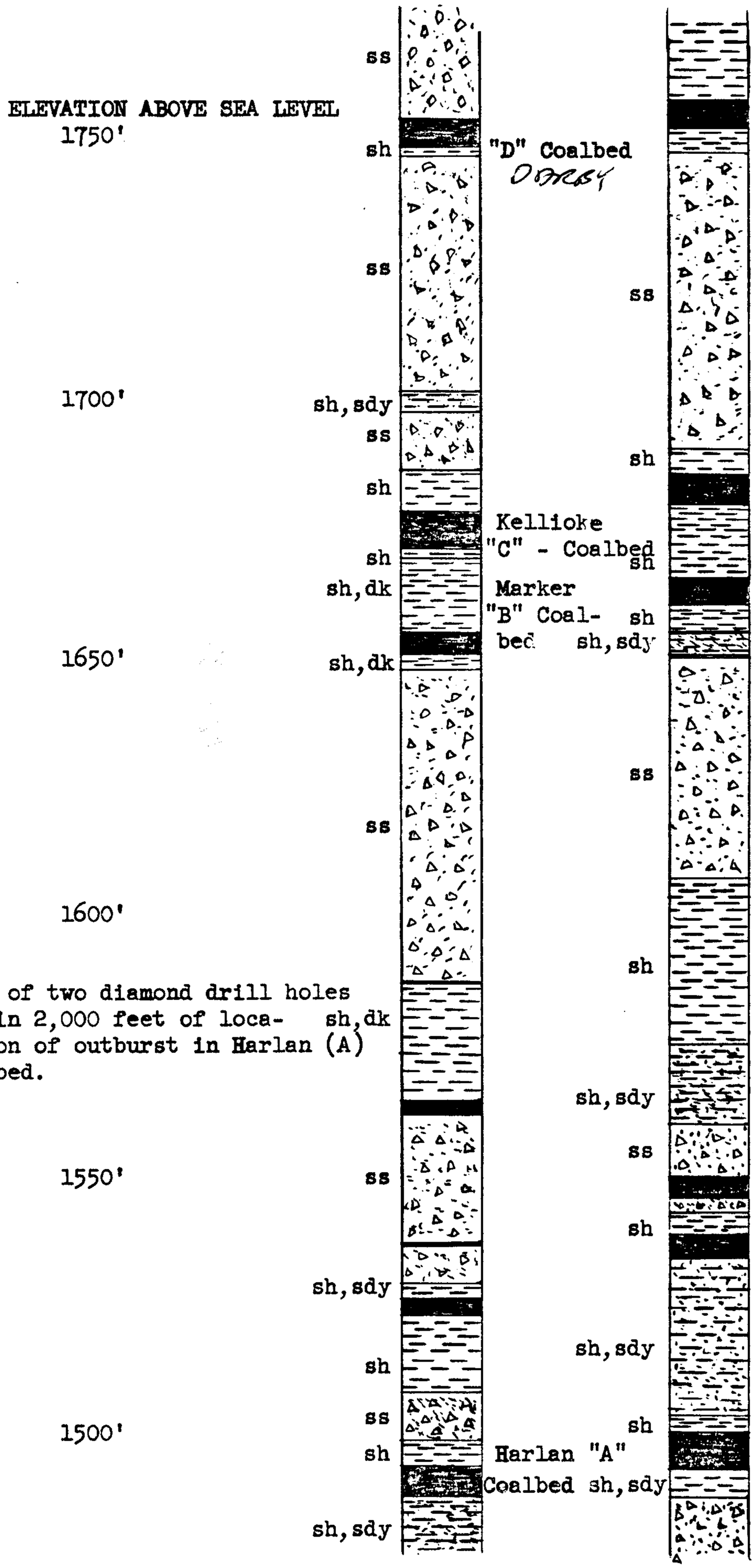

Logs of two diamond drill holes within 2,000 feet of location of outburst in Harlan (A) coalbed.

FIGURE 4